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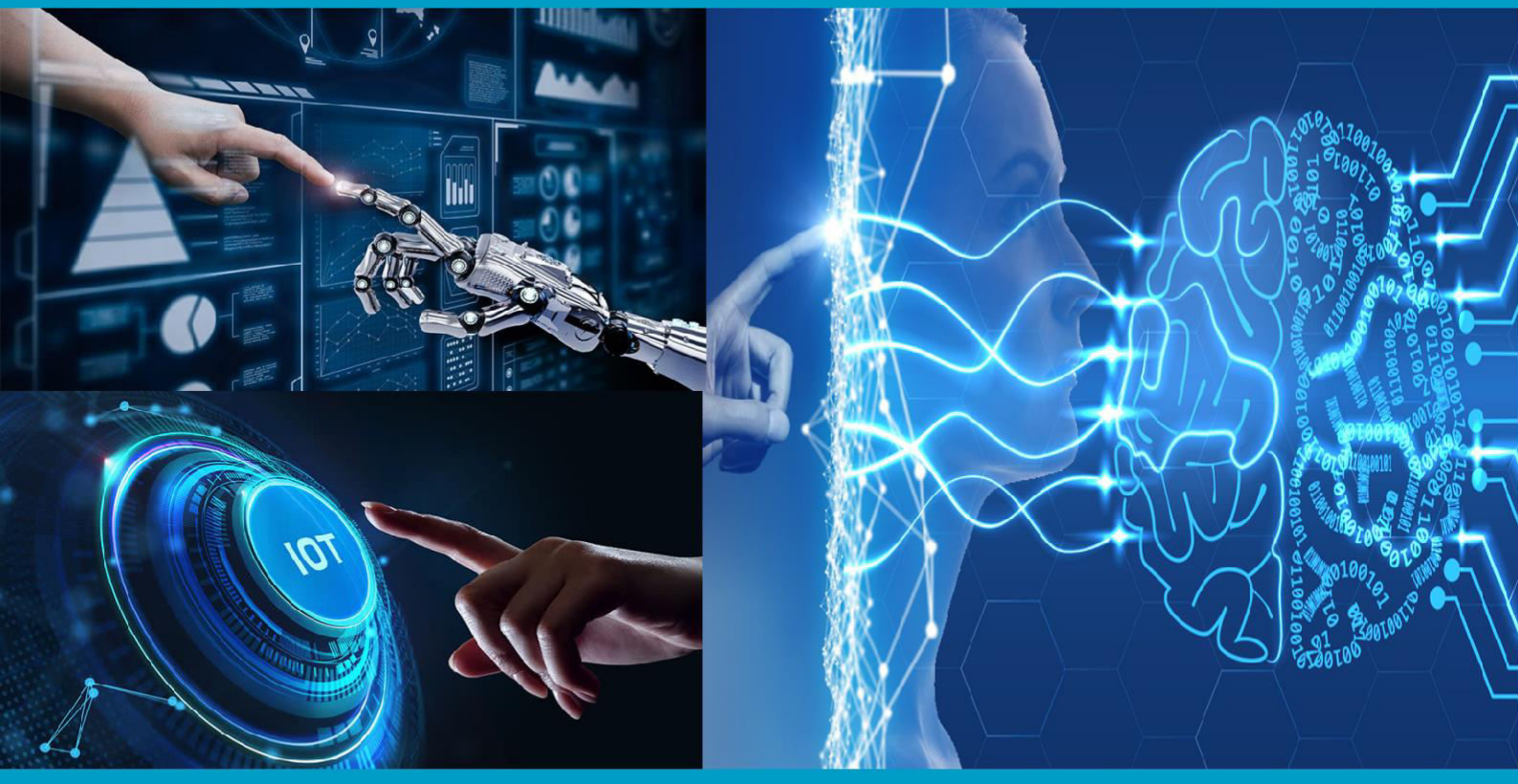

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A Review on "Biosorption of Heavy Metals Using Rice Milling By-Products, Characterization and Application for Removal of Metals from Laboratory Prepared Waste Water"

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ABSTRACT- The importance of removal of heavy metals from drinking water has received significant attention of researchers and decision makers across the globe. Bio-adsorbents have emerged as potential remediation materials for the removal of heavy metals and metalloids from both groundwater and surface water. Plants, algae, fungi are some of the biomass derived adsorbents which are capable of removing heavy metals and metalloids from aqueous solution by adsorption. For increasing the adsorption efficiency of bio-adsorbents, treatment of adsorbents is done by using various kinds of treating agents like tartaric acid, NaOH. The bio-adsorbents have affinity for heavy metal ions to form metal complexes or chelates due to having functional groups including carboxyl, hydroxyl, imidazole, sulphydryl, amino, phosphate, sulfate, thioether, phenol, carbonyl and amide etc. Rice husk (RH) is a low cost (agricultural by-product) bio-adsorbent which has been studied intensively for the removal of various heavy metals and metalloids (such as Pb, Cd, Zn, Ni and As) from both groundwater and surface water. The present study is focused on critical review of previous and current available information on potential of treated and untreated rice husk for the removal of heavy metals and metalloids (arsenic). Various studies on adsorption efficiency of rice husk considering the parameters contact time, adsorbent dose (rice husk), initial concentration of heavy metals, pH, and temperature have been evaluated by many researchers. The present study analyzed those studies and compiled the adsorption efficiency of rice husk and concluded that treated rice husk gave comparatively better adsorption efficiency of heavy metals with compared to that of untreated rice husk. The treated rice husk can be implemented on large scale industrial applications after field studies.

KEYWORDS: Adsorption Efficiency, Rice Husk, Bio-adsorbents, Drinking Water, Heavy Metals

I. INTRODUCTION

The importance of removal of heavy metals from drinking water has received significant attention of researchers and decision makers across the globe. Bio-adsorbents have emerged as potential remediation materials for the removal of heavy metals and metalloids from both groundwater and surface water. Plants, algae, fungi are some of the biomass derived adsorbents which are capable of removing heavy metals and metalloids from aqueous solution by adsorption. For increasing the adsorption efficiency of bio-adsorbents, treatment of adsorbents is done by using various kinds of treating agents like tartaric acid, NaOH. The bio-adsorbents have affinity for heavy metal ions to form metal complexes or chelates due to having functional groups including carboxyl, hydroxyl, imidazole, sulphydryl, amino, phosphate, sulfate, thioether, phenol, carbonyl and amide etc. Rice husk (RH) is a low cost (agricultural by-product) bio-adsorbent which has been studied intensively for the removal of various heavy metals and metalloids (such as Pb, Cd, Zn, Ni and As) from both groundwater and surface water.

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Statement about the Problem

Heavy metals in water are originated from waste water of many industries. These heavy metals have hazardous effects on environment and human health. A little exposure to these heavy metals even at low concentration can cause many serious diseases (Kumar et al., 2012; Marin et al, 2010). So, the removal of heavy metals from water is to be considered seriously. Many techniques are adopted for decontamination of heavy metals from water. These methods include chemical precipitation, adsorption by activated carbon, member separation methods, coagulation, etc (Matheickal and Yu, 1999; Juang and Shiau, 2000; Lacour et al., 2001; Yan and Viraraghavan, 2001).

The main disadvantage of these methods is high cost, low efficiency, labor intense operations, lack of selectivity. Therefore new methods are developed for decontamination of heavy metals from water (Gaballah and Kilbertus, 1998; Lee et al., 1998). So there is an urgency of finding new technique which will be effective to remove heavy metals from water. The new technique is of low cost, abundant in nature, has high potential for removal of heavy metals (Marshall et al., 1999; Wafwoyo et al., 1999; Vaughanet al., 2001).

The adsorbents used in this method are basically inexpensive sorbent material obtained from agricultural waste materials or from the by-products of other industries. The adsorbent material used for this project work is rice husk, as they are easily available in India, has great surface characteristics, posses a lot of free electrons, carbon, silica and hydrogen ions, which makes it a good adsorbent of heavy metals (Boota et al., 2009; Lasheen et al., 2012; Osman et al., 2010).

Objective and scope of the project

- To determine the chemical composition of rice husks.
- To establish optimized conditions and potentiality of rice husks for removing Cu (II), Zn (II), and Pb (II) ions from synthetically prepared effluent.
- To study the effects of pH, time and initial concentration of metals on Cu (II), Zn (II) and Pb (II) adsorption.
- To predict removal efficiency of rice husk.

II. LITERATURE REVIEW

The rice husk has high potential for removal of heavy metals like Cu, Zn, Pb in terms of its adsorption capacity, binding mechanisms, experimental conditions and pretreatment methods (Okoro & Okoro, 2011).

The survey shows that the rice husk has an equal or even greater adsorption capacity compared to other conventional adsorbents. In future it is expected to replace the traditional adsorbents used for decontaminating heavy metals from water as it has great advantages such as high efficiency even with low metal concentrations, low cost, no additional nutrients requirements, and easy operation (Boota et al., 2009; Lasheen et al., 2012; Osman et al.,2010).

The main advantage of rice husk over other conventional methods is its strong affinity and high selectivity towards heavy metals; this is because of the presence of binding groups on its surface (Banerjee et al., 2010). It is of low coast because of being generated from agricultural waste; this can be easily processed, applied and recovered without any adverse impact on the environment. It is eco friendly and innovative, sustainable waste management. The adsorption process of heavy metals from waste water is influenced by various physical and chemical parameters like pH, temperature, initial heavy metal concentration, amount of adsorbent, particle size of adsorbents etc. These parameters determine the overall adsorption through affecting the selectivity and amount of heavy metals removed. Among process parameters, pH has a significant role in controlling the adsorption of heavy metals. pH values can affect the surface charge of rice husk, the degree of ionization and speciation of heavy metals, the competition of the metal ions with coexisting ions in solution (Park et al., 2010).

As the pH of the solution increases, the adsorption capacity of rice husk changes, removal of cationic metals increases, whereas that of anionic metals decreases. At lower pH, the overall surface charge of rice husk will be positive. The H+

ions compete effectively with the metal cations causing a decrease in adsorption capacity. When pH values increase, the rice husk surface becomes increasingly negatively charged which favours the metal ions uptake due to electrostatic interaction. At very high pH, the adsorption stops and the hydroxide precipitation starts (El-Sayed et al., 2011; Njoku et al., 2011; Taha et al., 2011).

Heavy metal ions can transport from the solution to the surface of adsorbent owing to a driving force made by the initial metal concentration in the solution (Sahmoune et al.,2011; Taha et al., 2011).

It is found that maximum adsorption capacity of rice husk increases with increase in initial metal concentration in the solution. Time also has great impact on the adsorption capacity of the rice husk. With increase in time or duration of treatment of solution, the adsorption capacity increases. After 48 hours, there is only a negligible amount of heavy metal is found in the solution.

III. PROPOSED METHODOLOGY

For these experiments 100 ml of a solution containing Cu(II), Zn(II), and Pb(II) at 1ppm to 20ppm concentrations is to be added with the adsorbent and stirred continuously at 250 rpm speed in a electromagnetic stirrer for 24 hours at 40 degree constant temperature. Then the sample is allowed for settlement till clear water is seen on the surface, the sample the filtered and final concentration of metals is measured from the analysis using a Perkin-Elmer Model Analyst 200 atomic adsorption spectrometer. The experimental parameters affecting the bioaccumulation of Cu (II), Zn and Pb (II) species are examined. The effect of pH on the ability of rice husks to adsorb metal ions was investigated. For this purpose, the pH values of the Cu (II), Zn and Pb (II) solution are varied from 2 to 6. In order to evaluate the treatment efficiency for other metals, after establishing the optimal conditions for Cu, Zn and Pb(II) laboratory effluent treatment. Thus, the initial and final concentrations of these metals are also determined, and the results are recorded.

IV. CONCLUSION

The various studies on removal of heavy metals using rice husk which revealed that treated rice husk attracted more attention than untreated one due to comparatively higher adsorption capacity favored by higher number of active binding sites, improved ion exchange properties and enhancement of functional groups after chemical treatment. The treated rice husk may be implemented on large scale industrial applications after field studies.

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